Experiment in John Herschel's Philosophy of Science

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The aim of this work is to elucidate John F. W. Herschel's distinctive contribution to the inductivist tradition in the philosophy of science by (i) discussing his explicit views on experimental methods and the successes of experimental inquiry within his Preliminary Discourse on Natural Philosophy and (ii) proposing an epistemology of experiment adequate to support his claims about the epistemic value of experiment in scientific inquiry. I argue that the most basic principle underlying Herschel's epistemology of experiment is that experiment enables a particular kind of lower-level experimental knowledge or understanding of phenomena. Experimental practices provide knowledge of a particular phenomenon as a genuine effect produced under precise material conditions whose connections with other phenomena can be traced by variations in experimental parameters. The orienting concern of experimental inquiry seems to be the production of this secure knowledge of phenomena as such even if it has no direct theoretical significance. Insofar as one can generate such experimental understanding, it can function both as a fertile source for explanatory principles about phenomena and as body of evidence against which one can test the adequacy of an explanatory hypothesis. Thus, experimental understanding of phenomena is the substantive basis upon which one can draw inferences concerning the ultimate causes of phenomena. For Herschel, then, it seems that theoretical speculation is legitimate only if there is an adequate experimental understanding of phenomena upon which one can ground proposed explanatory hypotheses or theories.

Complicating this analysis, however, is the fact that Herschel does not provide a systematic analysis experiment in his Preliminary Discourse on Natural Philosophy; he catalogs various kinds of experiment and the functions they serve but provides no cohesive or unifying account of the normative epistemic principles grounding experimental inquiry. Although he extols the importance of experiment in scientific inquiry, Herschel fails to specify how or why experimental methods are capable of fulfilling their important evidentiary functions. For this reason, it is instructive to look beyond Herschel's philosophical reflections on the nature of experiment and to consider his own experimental work. Herschel's discussion of the processes of actual experimental research from the conceptualization of experiments to the explanation of experimental results can provide insight into the epistemic principles underlying his understanding of experimental inquiry.

In this paper, I consider a set of experiments Herschel performed with the assistance of Charles Babbage concerning a set of novel electromagnetic phenomena. In particular, these experiments focused on the communication of magnetism between physical bodies. A particularly troubling species of this general phenomenon was the ability of supposedly non-magnetic bodies, like copper, to communicate or induce magnetism in neighboring bodies. Originally discovered by Dominique François Arago, this phenomenon called into question the received theoretical view that there were some substances that could not be made to produce magnetic effects. In fact, in the Preliminary Discourse, Herschel argued that Arago's discoveries provided substantial, and nearly complete, evidence that "there is no substance but which, under the proper circumstances, is capable of exhibiting unequivocal signs of the magnetic virtue" (325). Thus, it was unclear whether one could draw a strict demarcation between magnetic and non-magnetic substances.

Important theoretical advances in electromagnetism gave further significance to this phenomenon. By the early 1820s, André-Marie Ampère had proposed and defended—on both experimental and

theoretical grounds—the view that magnetism was an effect of the activity of intermolecular electrical currents. One consequence of this view was that substances that do not conduct electricity should not be able to exhibit or produce magnetic effects. But Arago's effect seemed to indicate that all substances, even those substances thought to be non-conductive, could produce or exhibit magnetic effects. Hence, it was unclear how to reconcile Ampère's well-grounded electrodynamic theory with this novel evidence.

These theoretical contexts served as a catalyst for Herschel's and Babbage's experiments, but the experiments they conducted were not intended to test the adequacy of these theoretical views. Herschel's and Babbage's immediate goal was to understand the phenomenon itself. They were not initially or even primarily concerned with providing an explanatory account of the cause, or causes, of these enigmatic phenomena. It was only after they had developed an adequate experimental understanding of the phenomenon in question that they brought these to bear upon theoretical questions. And even then, their goal was not to settle the theoretical questions decisively; rather, they merely formulated some principles that they believed any adequate theory of the underlying productive causes of the phenomenon in question must explain.

Within the context of Herschel's philosophy of science, there are three main reasons to focus on these particular experiments. First, in the Preliminary Discourse, Herschel maintains that the emergence of the science of electromagnetism from the distinct scientific study of electricity and magnetism provides an excellent example of the success of experimental inquiry in the sciences. Thus, it seems likely that Herschel's experimental work within this domain may provide some indication of his understanding of the normative epistemic features of experimental inquiry. Second, given the relative infancy of the science of electromagnetism, Herschel's experimental work within this domain sheds light on one of the hallmark features of an inductivist understanding of the sciences—that is, the slow and cautious steps by which experimentalists move from particular observations to proposed explanatory principles. Third, closer scrutiny of his work in this domain is likely to provide some indication of Herschel's attitudes towards the legitimacy of hypothetical speculation within an inductivist philosophy of science. The importance of this final point should not be underestimated given that it was a point of serious contention among his fellow 19th-century British inductivists William Whewell and John Stuart Mill.